

spectra have been shaded automatically during the process of reproduction so as to equalise the intensity throughout.

As systematic work the 8-inch telescope covers all parts of the sky north of declination $-12^{\circ}5'$ from two to four times a year; the Cooke lens covers all parts available two or more times a month, and the transit photometer records all stars visible to the naked eye crossing the meridian every clear night.

Arequipa Station.—The 13-inch Boyden telescope has been used for photographing clusters containing probable variable stars. With this instrument 140 plates have been obtained; 2269 with the 8-inch Bache telescope and 919 with the 24-inch Bruce lens. From the examination of these latter plates 298 new nebulae have been found, of which 9 are spiral and 3 ring nebulae.

The long focus telescope is now back from Jamaica, where a long series of photographs of the lunar surface has been obtained under five different illuminations. These will furnish material for a photographic atlas. The diameter of the moon's image is about fifteen inches.

Blue Hill Meteorological Station.—Continued experiments are being made in the exploration of the upper atmosphere by means of kites, altitudes up to 12,550 feet having been obtained. Considerable success has attended the endeavour to fly the kites from ocean-going vessels in order to record weather conditions away from land surfaces.

TOTAL ECLIPSE OF THE SUN, MAY 18, 1901.—In *Popular Astronomy* (vol. x. pp. 1-4, January), Prof. A. N. Skinner gives an account of the expedition to Sumatra from the United States Naval Observatory. Three stations were selected, at two of which the weather conditions were unfavourable. At the third, Fort de Koch, excellent photographs of the corona and the chromospheric spectrum were obtained. The former were taken with a lens of 5 inches aperture and 39 feet focal length; two of these are reproduced with the article; the spectroscopic equipment consisted of a 30-foot concave grating spectrograph, with which six photographs were obtained.

A MAGAZINE OF SCIENCE AND PHILOSOPHY.¹

"ANOTHER new magazine!" But the editor, in anticipating this exclamation, suggests that it is no more reasonable than would be "Another new flower in the fields!" or "Another new tree in the wood!" Still, one is not obliged to pluck the flower or to cut down the tree; but a new magazine makes a certain claim on the attention of the public, especially as it is addressed to the scientific public as well as to philosophers in the stricter sense of the word. Indeed, it is an attempt to induce men of science to interest themselves more in philosophy and students of philosophy to pay more attention to modern science. It is not intended to serve as a means of popularising either of these regions of thought, and the editor promises to exclude all purely speculative matter for which an experimental basis is wanting.

The first number contains an interesting article by Mach on "Similarity and Analogy as an aid to Investigation," in which Huygens, Faraday, Maxwell and Kelvin are held up as examples of investigators who have made sound use of analogy and have contributed, in consequence, greatly to the progress of human knowledge. Wald contributes "Critical Studies on the most important Fundamental Conceptions of Chemistry." It must be confessed that this introduction (for more is promised hereafter) is not very intelligible. "The Principle of Continuity in the Mathematical Treatment of Natural Phenomena" is the title of an article by Anton Scheyer. The first chapter considers the principle as illustrated in the calculus; the second deals with the principle of continuity in natural science; the third, in mechanics; the fourth, in electrical and thermal phenomena; in the fifth the kinetic theory of gases is discussed; and the sixth chapter treats of the hypothesis of matter and of energetics. Here objections are raised to Ostwald's conclusion that "Our senses tell us of differences in energy between them and their surroundings"; for it is remarked that if equal quantities of energy be imparted to two bodies of equal mass yet of different specific heat, having the same initial temperature, while the final temperature of each will be the same, heat will

¹ *Annalen der Naturphilosophie*. Edited by Wilhelm Ostwald. (Veit and Co.). Price 14 Marks, yearly.

have passed from the one of lower to the one of higher specific heat; and yet each will affect the sense of temperature equally, though they have gained different amounts of energy. He insists, therefore, that besides energy there must exist some other magnitude which must not only be capable of mathematical treatment, but must be as necessary for the true description of occurrences as energy itself. He also questions whether the doctrine of energy suffices to describe such a stationary condition as two equal light-rays polarised at right-angles to each other, or to picture the stationary state which exists when energy flows in a field of permanent magnets and charged conductors, according to Poynting's law. For these and other reasons he regards it as probable that an interpretation of the universe will be more complicated than would be the case were Ostwald's energetic conception possible.

Ostwald contributes a critical article on Kant's "Metaphysical Basis of Science." To Kant's statement that true science must treat its subject-matter according to *a priori* principles, and that only science falsely so-called deals with laws deduced from experiment, Ostwald replies by denying the possibility of *a priori* conclusions, and maintains that all knowledge is derived from experience. Another celebrated dictum of Kant's is that in any investigation of Nature only so much real science is present as is expressible in mathematical terms; Ostwald insists, however, that mathematics is only a language in which the results of experiments may be conveniently expressed, and that it can contain nothing more in its conclusions than what experiment lends to its premisses. And while Kant, although acknowledging that in principle his scientific treatise has a close connection with the ordinary province of metaphysics, to wit, God, Freedom and Immortality, distinguished them sharply, regarding the former "as a shoot from the same root as the latter, but one which hinders its regular growth," Ostwald maintains that no stronger argument can be found for the necessity of a purely experimental basis for all branches of knowledge.

A somewhat technical article by Arthur von Oettingen on "The Dual System of Harmony," and one by E. Sievers on "Melody of Voice in (Reciting) German Poetry," are followed by reviews of new books by the editor. Among these it is somewhat amusing to find Judge Stallo's "Concepts of Physics," which has only now reached the German public, through its translator, H. Kleinpeter. W. R.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. T. H. Middleton, professor of agriculture in the Durham College of Science, Newcastle-on-Tyne, has been elected to the chair recently vacated by Dr. Somerville.

Dr. Barclay-Smith has been reappointed senior demonstrator of anatomy.

The Vice-Chancellor, Prof. J. J. Thomson, and Mr. R. T. Wright will represent the University at the jubilee of Owens College, Manchester, to be celebrated next March.

EDUCATION was given first place in the King's speech to the Commons at the opening of Parliament last Thursday. The words used were "Proposals for the Co-ordination and improvement of Primary and Secondary Education will be laid before you." It is to be hoped that a comprehensive measure will be introduced early in the session, and that nothing will be permitted to interfere with the settlement of the questions involved in it.

THE adoption of the metric system of weights and measures would be so much to the advantage of the work of education and commerce in this country that efforts should be made to bring the subject forward on every suitable occasion. We are, therefore, glad to see that the following resolution was passed at a general meeting of Convocation of the University of London on Monday:—"That this House is of opinion that, in the interests of commerce, science and education, legislation should be promptly undertaken to make compulsory in this kingdom, after a proper interval, the use of the metric system of weights and measures for all purposes."

PROF. ALFRED LODGE stated the case for reform in methods of teaching geometry at the annual meeting of the Mathematical Association held on Saturday last. He urged that a new text-book of geometry, framed more or less on the model

of books used in France, should be introduced as soon as possible to supersede Euclid's elements. Text-books adapted to modern needs are in use in the United States of America, and their chief characteristics are:—(1) The more orderly arrangement of propositions; (2) the entire separation of theorems from problems of construction, hypothetical constructions being used in proving a theorem; (3) the closer association of a proposition and its converse when both were true; (4) the adoption of arithmetical notions and algebraic processes; (5) the early introduction of simple *loci*; (6) insistence on accurate figures drawn by accurate and practical processes; (7) practice in exercises from the very beginning. It had been suggested to Prof. Lodge that he should add, "Attention paid to the various phases of a theorem as the figure changes, and (as the student progresses) to the easier forms of generalisation." The greater part of these improvements could be adopted at once, provided that the sanction of the great examining bodies could be obtained. A committee of the Association is being formed to cooperate with the committee of the British Association in advancing the reforms advocated in mathematical teaching.

THE work of the Sir John Cass Technical Institute, London, was inaugurated on January 15, when an introductory address was given by Sir William Roberts-Austen, K.C.B., F.R.S. The institute has been founded by the governors of Sir John Cass's Foundation, and is one of the London polytechnics aided by the Technical Education Board of the London County Council and by the City Parochial Foundation. The institute is situated in Jewry Street, Aldgate, and is readily accessible. It is provided with good laboratories for chemistry, metallurgy and physics, and on the art side with workshops and drawing rooms for the department of arts and crafts. Dr. C. A. Kohn is the principal of the institute. Sir William Roberts-Austen in his introductory address dealt chiefly with the subject of metallurgy. It was, he said, an industrial art depending for its success on what were called the applications of science, but he heartily wished that the term "applied science" had never been devised. There was no essential difference between what was called pure science and what was called applied. In industrial life they simply applied the facts of science to a particular set of conditions or to the solution of definite problems. This view was illustrated by reference to the process of cupellation, the history of which was described and illustrated by suitable experiments. The diffusion of solids was then referred to, and a summary was given of the steps that had led Sir William to the investigation of the diffusion of metals.

THE importance of geography in education was the subject of an address delivered by Mr. James Bryce, M.P., at the annual meeting of the Geographical Association held last week, Mr. Douglas W. Freshfield, president, being in the chair. The Association aims at the improvement of the teaching of geography by spreading the knowledge of all such methods as call out the pupil's intelligence and reasoning powers and make geography a real educational discipline, instead of merely loading the memory with names and isolated facts. After expressing his hearty sympathy with the objects of the Association, Mr. Bryce considered the place of geography in education under three aspects, viz., as the gateway to the physical sciences, the key to history, and the basis of commerce. In this country, as in Germany for some time, it is thoroughly realised by all progressive teachers that geography must be made as much as possible an experimental science—that the pupil's mind must be brought into contact with facts and not alone with words. The pupil taught to observe has it suggested to him how things are connected with one another; he acquires the habit of looking at the country and asking himself what are the physical causes which make the district what it is, and what is the relation between those different causes. As to geography being regarded as the basis of commerce, Mr. Bryce said that the producer and merchant ought to know where each article could be best produced, where the raw material comes from, what are the conditions of labour, which are the best points of manufacture, where are the best markets, and what are the lines of communication and transport. Although the commercial man has to rely upon trained observers he would do better if he acquired geographical knowledge himself, because he could develop for himself certain lines of policy upon which he could conduct his operations; his wider knowledge of the world would enable him to take, not only a more intelligent, but a more practically serviceable view of the action which in each particular case was

to be taken, and which, of course, would be constantly shifting. If the heads of great business houses were thoroughly trained to observe these things and to look at them in a scientific way, a great deal would be done to enable the country to hold its place in the great commercial world.

IN view of the recognition with which scientific training is now meeting, as part of our educational system, some of the suggestions made at the Conference of Public School Science Masters on January 18 are of interest. Those responsible for the framing of the regulations for Army examinations were unanimously recommended by scientific men from all the great public schools, and from many others, to lay more stress upon the practical side of the science work. It was, further, suggested to them that quantitative work should be introduced and that physics should be given the place it deserves in the compulsory science papers. Moreover, what is to be sought is not knowledge-worship, but training, not the old-fashioned theoretical questions with which examiners find it so easy to elicit facts, but the construction of problems which, when worked out practically under their own eyes, will truly tell them the capabilities of the candidates. Testimony was also forthcoming that there are examiners who will take the trouble to examine in the latter way, and the meeting was in favour of allowing that greater scope to assistant practical examiners which they must have if large numbers of persons are to be examined at one time. The pernicious specialisation which takes place in schools as a result of the examinations for science scholarships at the Universities of Oxford and Cambridge was made abundantly clear, and some system advocated which will prevent this and at the same time ensure all boys in the school—and not the "intellectual refuse" and Army classes alone—having a proper scientific training for several years, whether they be classical or modern, literary or mathematical. A committee, it has been arranged, is to take up the matter. A sidewind during the discussion, as to whether classical boys do better than others in scientific work elicited the fact that at Woolwich, for instance, no rule one way or the other could be laid down. The necessity of culture as well as scientific education was a point that was touched upon, and might well form the subject of a future discussion. Biology as a school subject was rather pooh-poohed by one representative from Cambridge University, while its importance was just as strongly urged by a public school master. It came as no surprise to those familiar with what occurred last year, that a definite association was formed as a result of the conference which will arrange for similar and possibly more frequent meetings in the future. Principal Rücker has consented to become the first president of the Association of Public School Science Masters—a body the constitution of which will be somewhat elastic, as it is difficult to define what is a public school science master, but the title is sufficiently rigid to specify the character of the Association.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 20, 1901.—"The Anomalous Dispersion of Sodium Vapour." By R. W. Wood, Professor of Experimental Physics, Johns Hopkins University, U.S.A.

The modern theories of dispersion show that the effect of an absorption band is to lower abnormally the refractive index of the medium on the side of the shorter wave-lengths and raise it on the side of the longer wave-lengths. In some cases even the refractive index may fall below one on the blue side of the band, which means that light of a certain wave-length travels through the medium at a higher velocity than in a vacuum. Substances showing this peculiarity are exceedingly opaque to light, a thickness of a few wave-lengths absorbing completely all of the light for which this peculiarity exists.

It is quite possible to conceive of a medium with a strong absorption band in the middle of the visible spectrum having a refractive index greater than unity for all waves longer than the absorbed waves, and a refractive index less than unity for all shorter waves. A prism made of such a substance would deviate half of the spectrum in one direction and half in another direction, something in the manner of the direct-vision prism, except that the arrangement of the colours would be anomalous. Such a medium has been found in metallic sodium vapour, which is most beautifully transparent in addition to having the peculiarity